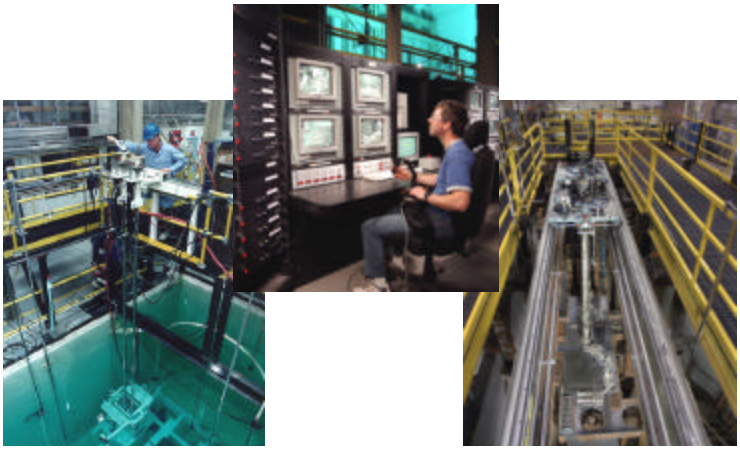
# Fuel Retrieval System

## *The Challenge*

Hanford's water-filled K Basins contain a large amount of uranium metallic fuel which was previously irradiated in the N Reactor. This fuel consists of approximately 100,000 fuel assemblies and is contained in stainless steel canisters. The Hanford Spent Nuclear Fuel Project has assumed the task of moving this fuel from K Basins to a new dry storage facility which is considerably farther from the Columbia River. This task includes remotely removing the fuel from its current canisters and placing it in 400 new large multi-canister overpacks (MCOs).



Left - fuel element decapping station, center – central control console, right – robotic (Konan) arm for loading fuel assemblies. Other system components not shown include canister slitting station, fuel sorting tables, underwater cameras and fuel cleaning machine.

The fuel is currently in various stages of degradation after two decades of underwater storage, resulting in radioactive sludge that is generated by the fuel. The release of this sludge during fuel movement has the potential to obscure and delay work. The canisters in K-West Basin, in particular, are sealed and therefore have the potential to trap hydrogen gas and radioactive species that are byproducts of corrosion and that are released to the basin during fuel handling. Observations made during characterization of the fuel also indicate that there is the potential for fuel assemblies to be stuck in their canisters because of corrosion-induced swelling such that standard tools will not remove the fuel.

K-West Basin is the first of the two basins to begin fuel removal. The challenge is to safely open the sealed canisters, remove the fuel, efficiently load MCOs, and deal with any effluent (particulate and gas) which may exit the old canisters during the process.

## *Current Approach*

Prior to the installation of the Fuel Retrieval System (FRS), fuel had been moved manually using poles or small grappling tools when characterization or fuel management necessitated such movement. This requires the handling of a 50-pound weight on the end of a 20-foot pole with an obvious potential of operator fatigue and risk of injury given the large number of fuel assemblies involved. Fuel movements, on the scale contemplated now, have not been under-taken in the past. No serious attempts to clean fuel (other than some experimental brushing) had been made prior to the current campaign.

### *Benefits and Features*

- Remote opening of fuel canisters
- Ability to extract fuel which is stuck in canisters
- Remote fuel movement with reduced risk to personnel
- Removal of sludge and adhering debris from fuel

Previous attempts to open canisters for fuel characterization did not have the ability to interface with large capacity gas or sludge mitigation systems. Installed equipment capable of emptying canisters with stuck fuel has not been available in the K-West Basin prior to FRS deployment.

### *New Technology*

The FRS has been deployed in the K-West Basin. It consists of a decapping station, a canister slitting station, fuel sorting tables, underwater cameras, a fuel cleaning machine, and robotic manipulator arms. The decapping station must deal with two completely different lid designs utilized for K-West canisters. Lids are dislodged by injecting pressurized water through valves that are imbedded in the lids. Contaminated water, trapped loose sludge and gas are diluted and flushed from the canisters into the appropriate disposal systems. Subsequently, double-barreled canisters are placed individually in the Primary Cleaning Machine for removal of all but the most tenaciously adhering sludge and fuel coating material. This machine is capable of tumbling an entire canister of fuel while pressurized water and the rocking motion of the fuel itself help dislodge particulate. Effluent from this machine is directed to the Integrated Water Treatment System (IWTS) which deals with the sludge entrained in the wash water. Fuel is then removed from the canisters to sorting tables. If the fuel is stuck in the canister, the fuel slitting station provides the capability to cut the canister walls vertically at two opposing locations and to force the barrel sides apart. Two robotic arms ("Konan Arms") are then used to load the fuel assemblies and pieces of various sizes into baskets, which in turn are placed in MCOs. Complete underwater camera coverage facilitates the fuel sorting, transfer and inspection processes.

The FRS is a multi-step system that provides for the efficient transfer of fuel, the capture of byproducts, and the capability to handle the multitude of different levels of damage in the fuel assemblies. This technology provides worker safety and increased productivity accelerating completion of the project.

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